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Arctic Indigenous Peoples as Representations and Representatives of Climate Change

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**ABSTRACT** Recent scientific findings, as presented in the *Arctic Climate Impact Assessment* (ACIA), indicate that climate change in the Arctic is happening now, at a faster rate than elsewhere in the world, and with major implications for peoples of the Arctic (especially indigenous peoples) and the rest of the planet. This paper examines scientific and political representations of Arctic indigenous peoples that have been central to the production and articulation of these claims. ACIA employs novel forms and strategies of representation that reflect changing conceptual models and practices of global change science and depict indigenous peoples as expert, exotic, and at-risk. These portrayals emerge alongside the growing political activism of Arctic indigenous peoples who present themselves as representatives or embodiments of climate change itself as they advocate for climate change mitigation policies. These mutually constitutive forms of representation suggest that scientific ways of seeing the global environment shape and are shaped by the public image and voice of global citizens. Likewise, the authority, credibility, and visibility of Arctic indigenous activists derive, in part, from their status as at-risk experts, a status buttressed by new scientific frameworks and methods that recognize and rely on the local experiences and knowledges of indigenous peoples. Analyses of these relationships linking scientific and political representations of Arctic climate change build upon science and technology studies (STS) scholarship on visualization, challenge conventional notions of globalization, and raise questions about power and accountability in global climate change research.

**keywords** climate change, global environmental change, indigenous peoples, indigenous knowledge, globalization, representation, visualization

## Arctic Indigenous Peoples as Representations and Representatives of Climate Change

*Marybeth Long Martello*

Victims of disease and disaster often become symbols and spokespeople. For decades, the Muscular Dystrophy Association (MDA) annually selected a poster child, a boy or girl to personify neuromuscular disorders and make their effects visible to the public. Poster children captured public attention and elicited sympathy and support, in part through their ability to convey their first-hand experiences with a devastating illness. In 1993, the MDA changed the label of poster child to one of goodwill ambassador, a title that more aptly reflects the role of these children, not only as icons, but as representatives of similarly affected children and as advocates for future research. Perhaps a descendent of the MDA's well-known Labor Day

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Telethon, the aid mobilization following the Tsunami tragedy of 2004 had its own poster children. The mammoth wave that swept away the lives of hundreds of thousands across South Asia elicited a worldwide outpouring of generosity. The aid campaign gathered force in large part through the pictures and profiles of loss and survival that resonated globally. Television and print media provided visibility and voice to the victims, while helping a world of onlookers to realize the humanity in those unfathomable death tolls.

For a number of global environmental risks and dangers the same high-impact forms of representation have been more elusive. Perhaps the most iconic images of environmental change have belonged not to humans, but to the charismatic megafauna that populate the websites and public relations materials of animal rights and environmental activist organizations. Polar bears and pandas are more familiar to world audiences than are the victims of dryland degradation, the consumers of mercury-laden fish, and the inhabitants of small islands. Until recently, climate change has been among the faceless forms of global environmental change, virtually devoid of human imagery and personal testimonials. Without even a non-human mascot, climate change science<sup>1</sup> and politics have played out through charts of greenhouse gas emissions, graphs of global mean temperature rise, maps of changing crop yields, and negotiations over carbon markets. Even Al Gore's 'An Inconvenient Truth' intersperses film footage with an abundance of charts, graphs, and maps. The first decades of climate change research tended to produce aggregate pictures of the people who both contribute to climate change and experience or stand to experience its effects in everyday life. Humans appeared as part of large geographically situated populations (for example, Africans, northern Europeans, South Americans) and/or as attached to particular livelihoods (for example, farming, fishing, tourism). Scientific representations<sup>2</sup> paralleled political representation in arenas concerned with climate change knowledge and policymaking: few specific individuals or groups (save the inhabitants of small island states) integrated the risks of climate change into their identities and politics.

More recently, scientists from fields as diverse as biology, ecology, geography, and anthropology (to name just a few) are altering the ways in which they view, study, and portray humans in relation to global environmental change generally, and climate change in particular. Changes in the conceptual models and practices of scientific inquiry are coinciding with the emergence of new forms of visual and political representation. Research into the effects of climate change on human–environment systems increasingly emphasizes the importance of human agency, human–environment interactions, social, cultural and economic factors, and local knowledge as essential for understanding the implications of global environmental phenomena. In addition, assessment programs are becoming more strategic and innovative about the presentation and dissemination of their findings to transnational audiences of decision-makers and ordinary citizens (see, for example, National Assessment Synthesis Team, 2000; Arctic Climate Impact Assessment, 2004; Kohler et al., 2004).

These developments are evident in the Arctic Climate Impact Assessment (ACIA) study (Arctic Climate Impact Assessment, 2004), a transnational study that examines the environmental and social implications of climate change for peoples inhabiting the regions around the North Pole. This assessment claims that climate change in the Arctic is happening now, at a faster pace than elsewhere on Earth, with important implications for the rest of the world, and with major economic and cultural impacts for Arctic indigenous peoples.

ACIA contains novel photographic and textual representations of Arctic indigenous peoples as both holders of valuable knowledge and as populations at risk of losing their ways of life to global environmental change. These representations appear alongside the emergence of Arctic indigenous peoples as political representatives working to mitigate the global environmental changes that threaten them. ACIA's 140-page synthesis document contains various visual images in the form of charts, maps and graphs. In addition, however, the report displays numerous photographs, many of which show Arctic indigenous peoples.<sup>3</sup> These images (approximately 40) and the accompanying texts present Arctic indigenous peoples as exotic, expert, and endangered. The production of the ACIA report and its images is coincident with an evolving political role for indigenous peoples. Arctic indigenous groups are garnering a prominent profile and voice in global change science and policy forums. In these forums, Arctic indigenous peoples are becoming recognized as holders of specialized knowledge, which is crucial for identifying and understanding local manifestations of global environmental change and attendant nature–society interactions. They appear as embodiments and harbingers of what climate change has in store for the rest of the world. Standing for and speaking on behalf of at-risk cultures and livelihoods, Arctic indigenous groups are now spokespersons. Their voices are buttressed by the authority of a science that recognizes and validates their history, experience, and knowledge, in part through visual imagery.

By examining visual images of climate change and the political voices of at-risk communities, the present paper explores the nature and meaning of representation in a globalizing world. It asks questions such as: In what ways are certain forms and strategies of scientific representation changing and what are the implications? What is behind new formations and expressions of particular human communities on the world stage? And how can we understand some of the relationships linking these two phenomena? I take up these questions in the following sections. A brief review of science and technology studies (STS) scholarship on scientific representation indicates that this literature illuminates some aspects of climate change science and politics in the Arctic. However, the Arctic case departs from typical STS assumptions about the nature of scientific objects, visual image-making in science, and political roles of scientific representations. Changing visualization practices and definitions of expertise in climate change science and politics suggest ways for rethinking or at least augmenting conventional STS approaches to scientific representation. Likewise, the Arctic case sheds new light on political representation as typically characterized in globalization

discourse. Critiques of globalization generally assume the environment to be a victim, a recipient of globalization's ills. Seldom do these critiques identify the environment as a site of globalization and consider ways in which scientific constructions of the global environment underwrite (or not) the identity and interventions of particular social groups (see, however, Jasanoff & Martello, 2004). An analysis of Arctic indigenous peoples as both representations and representatives of climate change shows that ways of seeing global environmental change and its implications for nature and society can bear in important ways on who is made visible as a global citizen and who speaks for global citizenries.

### Points of Departure

Scientific representation, political representation, and globalization are long-standing themes in STS scholarship. Arctic climate change science and politics speaks to this scholarship on at least three topics: (1) the production and circulation of visual representations; (2) the scientist as spokesperson; and (3) environmental globalization and its implications for the representation of citizens.

STS research has probed modes and meanings of visual representation for countless insights into, for example, the details of scientific practice (Latour 1987; Lynch & Woolgar, 1990), the nature of scientific objectivity (Daston & Galison, 1992), knowledge, power, and social relationships (Fyfe & Law, 1988; Latour, 1990), personhood and medical imaging of the human brain (Dumit, 2003), and the elements of visual culture (Alpers, 1983; Latour, 1990). These analyses valuably highlight varied forms of representation and the contingency of their meanings on visual media and on scientists' textual and discursive practices (Lynch & Woolgar, 1990: viii). Works in this field have similarly pointed to the immutability and mobility of images, resources involved in their creation and transportation, and the innumerable power relations, meanings and alignments that hinge upon them. Scientific inscriptions, for example, have been integral to developing the ways in which people argue, prove, and believe (Latour, 1990).

These contributions provide an important starting point for analyzing Arctic representations, while also indicating further room for theorization. Seminal STS literature on scientific representation tends to focus on products of scientific craftsmanship in the form of charts, graphs, equations, and drawings that generally circulate among scientific communities (Latour, 1987; Lynch & Woolgar, 1990; Daston & Galison, 1992) – though some authors do address the broader travels of these images through, for example, the media and the courts (for example, Dumit, 2003). ACIA's (Arctic Climate Impact Assessment, 2004) photographs differ, in several respects, from scientific representations typically addressed in STS literature. ACIA's pictures are the products of professional photographers; they circulate among both scientific and non-scientific readers; and they do not directly display data in the way that graphs, maps, and tables do. Yet these pictures complement and augment scientific texts while providing a window into the

production of scientific findings. The images depict the broadening scope of participants and audiences of global change assessments, an increasingly prominent role for people in the conceptual frameworks and practices of global change science, and scientific claims about the risks that climate change poses for Arctic indigenous communities.

Bruno Latour (1987) highlights another side of scientific representation. He focuses not on representation simply as the artful production of a likeness, but as an act of speaking on behalf of another. According to Latour, scientists are spokespeople for their objects just as elected officials are spokespeople for their constituencies. Latour's observation holds potentially interesting implications for the Arctic case where indigenous peoples are, in a sense, scientific objects. Who speaks for whom in this scientist-object relationship? And what is the role of representation (both scientific and political) in mediating this relationship? Answers to these questions in the Arctic context reveal an important role for environmental science in bolstering or inhibiting the visibility and voice of citizens. 'Globalization without representation' is a common expression in anti-globalization discourse. Anti-globalization activists lament the ways in which multilateral trade institutions and the proliferation of multinational corporations are allowing the degradation of democracy, environment and ways of life. They argue that sidestepping national regulations on labor, the environment and health and safety fosters a short-term vision that overlooks the need for sustainable natural resource use and robs the world's inhabitants of their rights as citizens. The effects, they say, are most pronounced in largely voiceless and invisible indigenous communities that are at risk of losing their distinct cultures, languages, identities, environments and livelihoods.<sup>4</sup>

In these globalization critiques, the environment generally appears, like these indigenous peoples, as a victim, rather than an agent or manifestation of globalization. Over the past generation, however, the environment, like trade, communication and the media, has also globalized. Weather, nature, pollution, and dryland degradation, previously thought of as exclusively local in origin and effect, are now also recognized as global phenomena involved with climate (Miller & Edwards, 2001), biodiversity (Takacs, 1996), trans-boundary air pollution, and desertification (Long, 2000, Martello, 2004b). The construction of a global environment has taken place through scientific practices, instruments, and claims, and through the rise of multilateral environmental institutions. General circulation models and insights into the dynamics and impacts of climate change underwrite the Intergovernmental Panel on Climate Change and the *Framework Convention on Climate Change* (Miller & Edwards, 2001). The idea of biodiversity has galvanized transnational stewardship of natural resources and ecosystems (Takacs, 1996). Changing approaches to knowledge, map-making and quantification were central to the emergence of dryland degradation as a global issue addressed via the *Convention to Combat Desertification* (Martello, 2000, 2004b). The emergence of the global environment has interestingly accompanied, and in many cases facilitated, the recognition and expression of particular local peoples and voices while perhaps downplaying the visibility and voice of others (Jasanoff & Martello, 2004).

## The Changing (Visual) Culture of Climate Change Science

Over the past 30 years, environmental globalization has entailed marked changes in what science deems worthy of observation and in who counts as a worthy observer. Conceptual frameworks for thinking about global environmental change have placed greater and greater emphasis on understanding relationships linking people and environments. This trend has accompanied an increasing focus on human agency and a broadening definition of expertise. Scientists, for example, who once modeled people as passive victims in the face of environmental change, now probe specific ways in which people understand, respond and adapt to, and otherwise interact with the environment. Scientists, decision-makers and others concerned with global change also recognize that knowledge about the manifestations of global change and attendant human–environment interactions reside, not only with scientists, but also with the very people who are part of the interactions in question (National Assessment Synthesis Team, 2000, 2001; Krupnik & Jolly, 2002; Turner et al., 2003a,b). At the same time, these various experts present their knowledge claims to increasingly broad and diverse audiences. Communication about climate change, for example, takes place not only among scientists and policymakers and through scientific journals and assessment processes, but also with the general public through book, newspaper, television and magazine accounts (Oppenheimer & Boyle, 1991; 60 Minutes, 2006; Kluger, 2006; Revkin, 2006). These transformations would suggest that there are important changes underway in what Alpers (1983) (also see Latour [1990]) would call a visual culture – in what it means to see climate change, what there is to see in climate change, and who is looking. Yet, not until recently were changing definitions of climate change and climate change expertise accompanied by equally striking developments in the visual imagery of climate change.

### *Dumb and Invisible Farmers*

The evolution of global change science is evident in changing notions of climate change impact. Over the past 30 years, national and local governments, non-governmental organizations, research institutions, and inter-governmental bodies have sponsored and engaged in processes commonly known as climate change assessments – social processes in which scientists, often with input from policymakers and other interested parties, convene to produce, negotiate, and pull together knowledge about the nature of, consequences of, and responses to, climate change. Generally, these processes produce a report or other document. Many such reports focus on the category of climate impact, which generally refers to the risks and consequences that are arising or could arise from a gradual warming of the Earth. A historical review of impact assessments conducted by US and transnational bodies of scientists between 1970 and the mid-1990s reveals changing notions of ‘impact’ over time (Martello & Iles, 2005). The

meaning and depiction of ‘impact’ have evolved with assumptions about the nature of climate change, who or what is at risk, available resources for understanding and addressing risk, and the composition of the assessment audience. Early assessments in the 1970s, for example, tended to rely on simple cause-and-effect models to examine global mean temperature rise and its implications for measurable and aggregated variables such as crop yield, soil moisture and mean sea level (for example, Climatic Impact Assessment Program, 1975). Some very early climate studies were later criticized for adopting a ‘dumb farmer’ approach in which farmers were assumed to have little if any foresight or insight into potential or actual manifestations of climate change (Smit et al., 1996; Adger & Kelly, 1999; Ford & Smit, 2004). Early studies also looked to scientific expertise and technological fixes as the primary resources for understanding and addressing climate change. The assumed audiences for these studies tended to be scientists and policymakers. Particular people did not feature prominently in these early investigations into climate change and photographs were rarely included in these accounts. More prevalent were graphs of projected global mean temperature, maps of soil moisture, and charts showing economic losses due to the flooding of coastal areas. Through the eyes of (largely) natural scientists, climate change often showed up as something that happened *to* aggregate populations (North Americans, Africans, and so on) and *to* aggregate societal sectors (energy, forestry, coastal areas, and so on).

### *Smart and Invisible Farmers*

Over the past 30 years, global change assessments, including those focused on climate change, have gradually employed more complicated conceptual models that attempt to account for the interaction of climate change with other forms of global change (ozone depletion, pollution, biodiversity loss) and with society (National Assessment Synthesis Team, 2000, 2001; Arctic Climate Impact Assessment, 2004, 2005). Vulnerability, for example, is an increasingly prominent organizing concept in global change research. Vulnerability research focuses attention on a particular (‘local’) human–environment system experiencing and or expected to experience environmental and social change. Vulnerability research also analyzes the ability of this system to adapt, mitigate, or otherwise interact with these forms of change. Whereas earlier assessments focused on economic and health losses, more recent assessments are also recognizing cultural and social forms of loss. And while early studies tended to highlight science and technology as offering the best resources and recourses in the face of global change, more recent approaches point to the role of history, local knowledge, and culture as essential for making sense of climate change and figuring out what to do about it (for example, Turner et al., 2003a,b; Martello, 2005).

The US National Assessment of the impact of climate change on the USA (National Assessment Synthesis Team, 2000, 2001) is an assessment that reflects many of the above developments in climate change analysis. In



fact the ACIA's Chair, professional writer, and graphic artist also participated in the NAST process. NAST employed 'vulnerability' (Turner et al., 2003a,b; Martello, 2005) as a central framing device in its analysis of nine US regions. The study was groundbreaking in its reliance on dialogues between assessors, decision-makers, and affected populations. It convened 20 workshops across the country to bring together scientists with government agencies, local institutions, corporations and other stakeholders, and decision-makers. The process encouraged dialogue between stakeholders who could share their perspectives and information needs and scientists who could explain climate change projections and possible consequences. These discussions provided a foundation for regional assessments by identifying key issues and data needs.<sup>5</sup> One might expect that such changes in the culture of climate change assessment would show up in the way that assessors depict climate change. NAST leaders were innovative in hiring a professional writer and graphic artist to work on the assessment. The assessment reports are replete with colorful charts, maps, diagrams, and photographs. However, unlike in ACIA reports, photographs of people are scarce, with most photographs depicting technologies such as dams and farming machinery and natural scenes such as snow-capped mountains, oceans, and forests. In addition, the public dissemination process for the NAST findings was relatively modest compared with the extensive public relations efforts accompanying ACIA's publication (Arctic Climate Impact Assessment, 2004). When asked about the lack of infrastructure to handle publicity, two individuals with significant roles in the assessment replied that it simply 'wasn't in the culture'.<sup>6</sup>

### *Visible Endangered Experts*

As in climate change impact assessments more broadly, analysis and visualization techniques in Arctic climate change science are changing with modes and practices of knowledge-making. The Arctic itself has been constructed as a meaningful region largely through scientific institutions and research (Martello, 2004a). Recent analyses of climate change in the Arctic are intersecting, with long histories belonging to indigenous peoples – histories of adaptation, ingenuity, resourcefulness, community, spirituality, and strength, but also of occupation, oppression, racism, and social, economic, and health problems. Environmental science has had its own role in these histories. Historical accounts of expedition and discovery tend to highlight charismatic explorers and scientists as heroes, while downplaying and often altogether overlooking the contributions and relevance of indigenous peoples as workers, guides, interpreters, and knowledge providers (Woodman, 1991; Brewster, 1997). And researchers have been known to intrude on Arctic indigenous communities to study their lives and environments, only to leave and forget about them after data collection is complete (Smith & McCarter, 1997). Town and tribal governments and other institutions involved with Arctic research have established rules and protocols for scientists whose research questions lead them to indigenous communities and their lands. Moreover, indigenous peoples are now initiating and receiving credit for a

number of groundbreaking and high-profile projects that present indigenous knowledge about climate change and other forms of environmental change. In 1999 The International Institute for Sustainable Development (IISD) and the Hunters and Trappers Committee of Sachs Harbour on Banks Island, Northwest Territories, undertook a year-long project to document and communicate evidence of Arctic climate change and how it alters the environment in which Inuvialuit live. The project produced several scientific papers and a film (International Institute for Sustainable Development, 2000).<sup>7</sup> Delegates at the 2000 Conference of Parties (COP) to the United Nations *Framework Convention on Climate Change* (UNFCCC) viewed this video. Nunavut Tunngavik Incorporated (NTI), the organization that represents Inuit under the 1993 Nunavut Land Claims Agreement, sponsored a 3-day workshop in March 2005 in Iqaluit. At the workshop, a group including elders, hunters, trappers, Inuit organization staff, government representatives, and scientists discussed Inuit perspectives on climate change adaptation challenges in Nunavut (Nunavut Tunngavik Incorporated, 2005). *Voices from the Bay* (McDonald et al., 1997) is a traditional-knowledge-based study of environmental change, published by the Canadian Arctic Resources Committee and the Environmental Committee of the Municipality of Sanikiluaq on the Belcher Islands in Hudson Bay. This study is based on 17 workshops involving 78 Inuit and Cree hunters and elders from 28 communities on the Hudson and James Bay shores.<sup>8</sup>

These and other projects have presented indigenous perspectives on a number of climate-related trends in weather predictability, snow quality, seasonal changes, sea ice, and precipitation. Indigenous insights into the nature of these changes, the implications of these changes for indigenous livelihoods, and the history of indigenous adaptations to past Arctic conditions are playing an important role in climate change science. Scientists are recognizing Arctic indigenous peoples as experts on human–environment relationships and crucial contributors to global change knowledge-making who risk the loss of century-old cultures, relationships, and ways of life (Krupnik & Jolly, 2002). Researchers similarly rely on people affected or potentially affected by environmental change to gain a better understanding of the values and priorities attached to environmental conditions and nature–society dynamics (National Assessment Synthesis Team, 2000, 2001). Indigenous peoples are also showing up visually in climate change research in ways that other experts and at-risk communities have not. For example, photographs of previously nameless and faceless indigenous peoples have recently graced the covers of environmental books (Krupnik & Jolly, 2002), a National Science Foundation research prospectus (National Science Foundation, 1997), non-governmental organization newsletters (World Wildlife Fund, 2004), and CD-ROM databases (Fox, 2003).<sup>9</sup>

Nowhere are these developments in Arctic climate change science more apparent than in ACIA. ACIA stresses the importance of place-based inquiries, human agency, and indigenous perspectives in understanding climate change. ACIA also suggests answers to the above-mentioned questions: Who is (or should be) looking at climate change? How do we best see climate change, and what is there to see in climate change?

ACIA is a project of the Arctic Council and the International Arctic Science Committee (IASC). The Arctic Council is a high-level intergovernmental forum involving eight Arctic countries (Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden, and the USA) and six indigenous peoples' organizations. These organizations are called Permanent Participants in the Arctic Council and they include the Aleut International Association, Arctic Athabaskan Council, Gwich'in Council International, Inuit Circumpolar Conference, Saami Council, and Russian Association of the Indigenous Peoples of the North. IASC is a non-governmental organization that facilitates cooperation in all aspects of Arctic research in all countries engaged in this research. ACIA engaged an international team of more than '300 scientists, other experts, and knowledgeable members of the indigenous communities' (Arctic Climate Impact Assessment, 2005: iii). The process spanned 5 years and produced a scientific document (Arctic Climate Impact Assessment, 2005) and a synthesis document (Arctic Climate Impact Assessment, 2004) intended for lay people and policymakers.<sup>10</sup>

ACIA catalyzed interdisciplinary and transcultural collaborations while reinforcing and augmenting existing professional networks. ACIA's scientific document is organized into 18 chapters. One of these chapters is devoted to 'The Changing Arctic: Indigenous Perspectives', while others address topics such as wildlife management and conservation, infrastructure, and human health. Each chapter was authored by a writing team consisting of one or two lead authors, as well as contributing and corresponding authors. Throughout the ACIA process, permanent participants strongly advocated the involvement of indigenous peoples, both in the oversight and running of the assessment process, as well as in the development of its technical content. Assessment leaders were highly supportive of indigenous participation. Originally it was intended that indigenous peoples would participate in the drafting of each chapter. However, their involvement varied from chapter to chapter, with indigenous peoples writing and reviewing portions of some chapters, while participating less actively in others. The synthesis document, written for the general public, presents ten key findings from the assessment along with evidence supporting them. While climate change might result in some welcome opportunities, ACIA sees indigenous peoples as standing to lose a great deal from it. At risk are livelihoods, cultural and spiritual practices, food supplies, and languages that have for centuries been rooted in the close connections between Arctic indigenous peoples and their environments. ACIA portrays the knowledges and experiences of these peoples as helpful for understanding the changes that have taken place, how indigenous peoples have coped with those changes in the past, and how they and others might address them in the future.

ACIA's representation strategies reach beyond the pages of its texts, as its products circulate outside of scientific communities. ACIA joins other recent scientific assessment programs in placing considerable emphasis on public outreach. Primary audiences for large assessment endeavors have historically included scientists and policymakers. More recently, assessors have sought to reach a wider range of decision-makers and ordinary citizens (see, for

example, National Assessment Synthesis Team, 2000, 2001; Arctic Climate Impact Assessment, 2004; Kohler et al., 2004). As reflected in its Implementation Plan, the ACIA process, and attendant communication strategies were built on the notion that an assessment should ‘provide policy-makers, planners, managers, organizations, and often the public, with documents and other communication media that can support the policymaking process’.<sup>11</sup>

Unlike many of its assessment predecessors, ACIA developed and implemented a communications and outreach strategy through which the assessment team, with help from a public relations consulting firm, publicized ACIA findings. Publicity included a formal media ‘roll out’ that coincided with the release of the synthesis document in early November 2004. During this rollout more than 200 major newspapers and a number of television stations worldwide carried stories about ACIA and its messages about climate change in the Arctic (for example, *Boston Globe*, 2004; Geertz, 2004; Heilprin, 2004; Revkin, 2004; Tirone, 2004; Xinhuanet, 2004). Many of these stories highlighted the implications of climate change for indigenous peoples. The Chair of the Assessment, Robert Corell, spoke with the US Congress, tribal groups, governments, diplomatic leaders, and the media about ACIA’s findings.

ACIA also spread its message via film and the Internet. In conjunction with the Center for International Climate and Environmental Research – Oslo (CICERO), ACIA produced a 19-minute film about ACIA’s claims. The film provides dramatic footage of changing Arctic landscapes, highlights key findings from ACIA reports, and ends with reflections on what kind of political action can be taken in response to climate change. The film includes interviews with Robert Corell, indigenous leaders, ACIA scientists, and members of Arctic country governments, including US Senators Hillary Clinton and John McCain. The ACIA has a web presence serving as its Public Education and Outreach Centre.<sup>12</sup> This site summarizes the project’s ten key findings, provides links to related web resources and background information about the assessment, and presents relevant policy statements by the Arctic Council.

ACIA is unusual for a major transnational climate change assessment, in part because it brings together scientific data on phenomena such as global sea level rise, temperature rise, and forest fires, with indigenous peoples’ perspectives on variations in sea ice and weather predictability. The professional writer who authored ACIA’s synthesis document described her desire to ‘present some of the indigenous observations in a more typically “scientific” way – such as using graphs and tables ... as well as include an occasional personal quote from a scientist’.<sup>13</sup> ACIA’s reports, like much published Arctic global change research, uses quotations to present insights and observations of indigenous individuals. Personal quotations from scientists are much rarer in climate change science literature.

ACIA displays quotations in a large font in the margins of the synthesis document. Quoting an indigenous resident of Nome Alaska:

Ice is a supporter of life. It brings the sea animals from the north into our area and in the fall it also becomes an extension of our land ... When it

starts disintegrating and disappearing faster, it affects our lives dramatically. (Caleb Pungowiyi, quoted in Arctic Climate Impact Assessment, 2004: 24)

Quoting a scientist from the University of Colorado:

That year [2002] the melt was so early and so intense – it really jumped out at me. I'd never seen the seasonal melt occur that high on the ice sheet before, and it had never started so early in the spring. (Konrad Steffan, quoted in Arctic Climate Impact Assessment, 2004: 40)

ACIA also uses bullet points and tables to suggest the generalizability of specific indigenous claims about environmental conditions. This style of presentation echoes efforts on the part of international organizations (particularly those concerned with environment and development) to systemize indigenous knowledge (see Martello, 2001). A bulleted list presents observed climate change impacts in Sachs Harbour, Canada. Table entries fall under headings such as physical environmental changes, environmental predictability, and travel safety on sea ice. A table presents generalized statements about changes in weather predictability, snow characteristics, sea ice and seasonal weather patterns. Indigenous anecdotes appear below each general statement as supporting evidence.

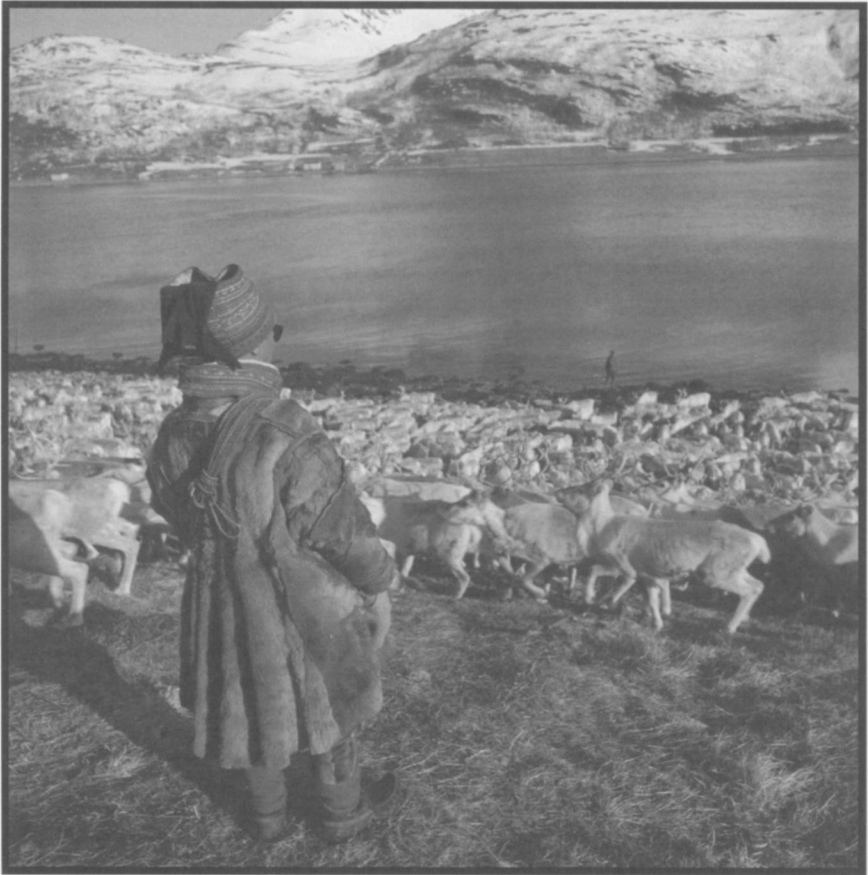
ACIA's photographs, like its quotes, lists, and tables, reflect new ways of seeing and understanding climate change. Some of the ACIA photographs show landscapes, technologies, environmental phenomena, and non-indigenous peoples. More frequently, however, they depict Arctic indigenous peoples interacting with each other, and their environments. These photographs are not the direct product of scientific craftsmanship. Rather, all of the photographs contained in the synthesis report's section on indigenous peoples derive from a professional photographic studio, Bryan and Cherry, that specializes in photographs of the Arctic and Antarctic. The photographs, situated in the page margins and without captions or reference in the text, portray indigenous peoples (mostly men) from diverse tribes and engaged in a variety of activities related to the environment. Many of the photographs depict indigenous peoples dressed in traditional clothing. The photographs include pictures of a Saami man herding reindeer (Figure 1)<sup>14</sup> and Eskimos in Point Hope, Alaska, removing skin and blubber from a Bowhead whale.<sup>15</sup> Perhaps one of the most vivid and memorable of these images portrays an Inuit man, dressed in traditional garb, holding a harpoon and jumping ice floes in Nunavut (Figure 2).<sup>16</sup> This photograph captures many dimensions of a culture at risk, including hunting, food, clothing, and relationships with nature. Photographs do not appear in the scientific report, suggesting that they are intended for a more general audience, including policymakers, the media, and the general public. These photographs are not built upon scientific observations, measurements, and interpretations in the same way that charts, graphs, and maps are. They depict endangered peoples and places as both exotic and identifiable; they localize and personalize climate change in the same way that animal rights websites make massive and terrifying polar bears seem cuddly. They do not show the technicalities of soil moisture changes or estimates of economic gain and loss. Yet they do reflect

scientific claims about threats facing indigenous communities. Scientists have deemed the environments, social relationships, human–environment interactions, cultures, traditions, and livelihoods depicted in these photographs as being at risk.

Where and how do non-indigenous peoples appear in ACIA reports? Do they constitute a new generation of nameless and faceless Arctic

**Figure 1**

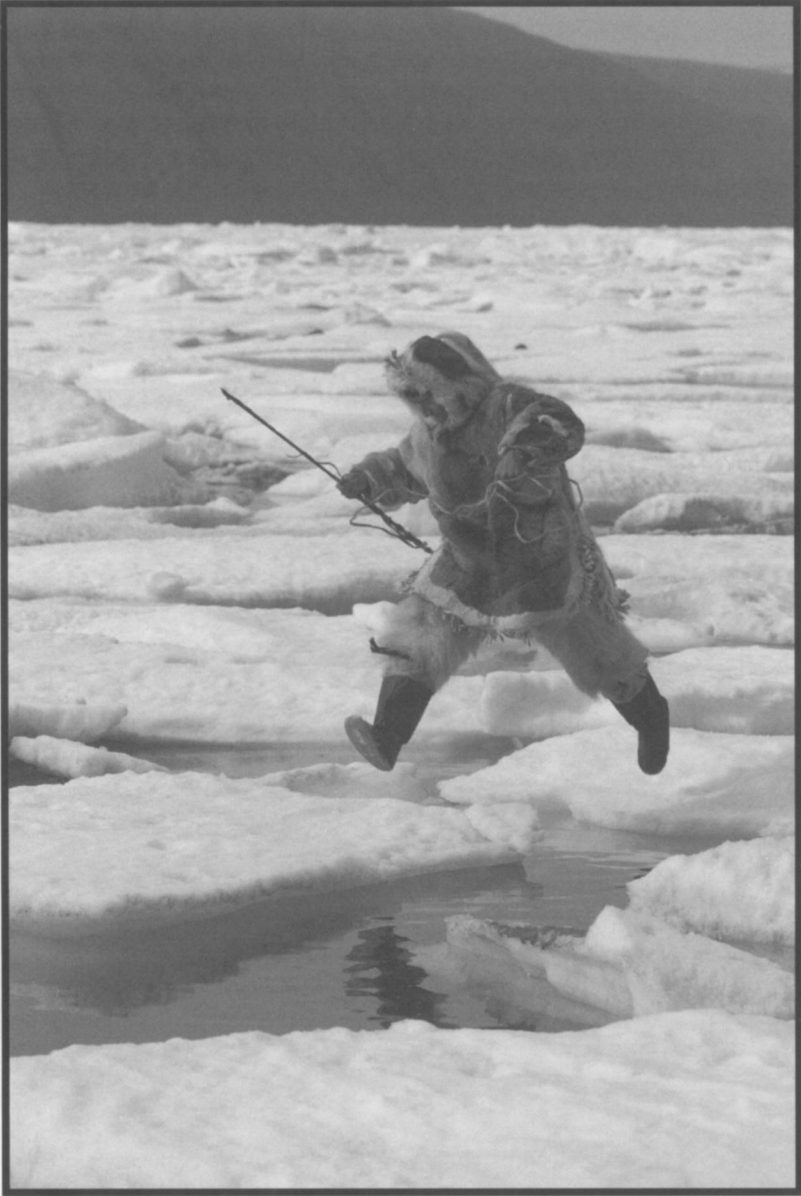
**'Sami reindeer herder with his reindeer at the end of the spring migration. Norway.'**  
©B&C Alexander/Arcticphoto.com



inhabitants? For a partial answer to this question we can turn to more of ACIA's visual images. Two notable figures appear in a section of the synthesis report entitled 'People of the Arctic'. Because of their size and detail these pictures could not be adequately reproduced here, but are available at <<http://amap.no/acia/>>. Download the pdf file for 'ACIA Overview report (part A)' and scroll to page 7.<sup>17</sup> The larger of the two images appears at the center of the page and depicts the Arctic region with land and ocean areas, the names of nation-states and several rectangles scattered about the

**Figure 2**

'Inuit hunter jumps from one ice floe to another. Ellesmere Island, Nunavut, Canada.'  
©B&C Alexander/Arcticphoto.com



land masses. The rectangles are color-coded, each corresponding to one of six indigenous groups, each a Permanent Participant in the Arctic Council. Another, much smaller version of the same Arctic map appears in the upper right-hand corner of the page. Superimposed on this smaller map are eight pie charts, one for each of the eight Arctic countries. The orange slices of the pie charts indicate the portion of the population that is indigenous and the green slices of the pie charts stand for the non-indigenous populations.

This graphic is symbolic of the treatment of indigenous and non-indigenous peoples throughout the report. The ACIA text refers, by name, to particular indigenous groups and often depicts them in anecdotal and personal fashion. Non-indigenous peoples (though also facing both risks and opportunities from climate change) generally appear in aggregate, without specific reference to names, cultural practices, and histories. Interestingly, scientific representations of indigenous and non-indigenous peoples correspond to their political representation in climate change policy debates. As discussed further below, certain Arctic indigenous peoples and their first-hand experiences with climate change are becoming an increasingly vocal and visible feature of global climate change discourse as evidenced by, for example, speeches, websites, scientific reports, media accounts, and interventions during international policy negotiations. While some indigenous groups and individuals (particularly among the Inuit) are establishing a familiar voice in climate change deliberations, most non-indigenous populations of Arctic and other countries remain nameless and faceless beyond their aggregate national identities.

## Political Visions and Voices

Just as ACIA and other climate studies are beginning to humanize climate change knowledge, certain Arctic indigenous groups are attempting to infuse climate change politics with a human face and voice. Their activism is rooted in a symbiotic relationship linking global change science with Arctic institutions and indigenous identities. Global change science has played an important role in constructing the Arctic as a meaningful category, in part, by portraying the Arctic as a geographic area victimized, as it were, by global transformations. Such portrayals by global change science buttress a number of pan-Arctic alliances. The environment, for example, was an early and prominent focal point for pan-Arctic cooperation through the Arctic Environmental Protection Strategy (AEPS), a precursor to the Arctic Council through which the Arctic nations and indigenous peoples' organizations cooperated on environmental protection and sustainable development. Concerns over the global environment have emerged with renewed interest in the protection of indigenous ways of life. In recent years, indigenous peoples have come together to address forms of environmental degradation that endanger their identities, cultures, and livelihoods. Many indigenous coalitions in the Arctic cohere around goals and principles of environmental protection. And as detailed above, indigenous involvement in global change research is helping to augment and validate scientific claims. Global change science, then, is both a part and a reflection of Arctic indigenous identity and its expression on the world stage (Martello, 2004).

Linkages between global change science and indigenous identity and activism are perhaps most vividly showcased in the work of the Inuit Circumpolar Conference (ICC). The Inuit present themselves as both symbols of climate change and spokespeople for the populations it puts at risk. The ICC, established in 1977, represents approximately 150,000 Inuit from Alaska, Canada, Greenland, and Chukotka (Russia). The ICC aims to strengthen unity among Inuit of the circumpolar region, promote



Inuit rights and interests on an international level, and develop and encourage long-term policies that safeguard the Arctic environment. Sheila Watt-Cloutier, originally from Kuujuaq, northern Quebec, served as Chair of the ICC from 2002 to 2006. She championed issues such as sustainable development and northern education, and raised concern about persistent organic pollutants (POPs) and climate change. She previously served as President of the ICC (Canada) and Vice-President of the ICC (Karaowski, 2004). Under Watt-Cloutier, the ICC strategically sought to develop a high profile on global change issues and to be a leader on these issues among northern indigenous peoples.<sup>18</sup> When Inuit describe global change and its implications for themselves and other Arctic indigenous peoples, they also articulate a basis for indigenous peoples' standing in global policy forums. In doing so, they portray indigenous peoples in much the way they are described and pictured in ACIA: they live closely with the environment; hold valuable environmentally rooted knowledge and traditions important for diet, spirituality, culture, and economics; and serve as embodiments, harbingers, and humanists for global change.

Climate change is one of many global ills that are traveling to the Arctic from sources beyond the region's borders. As such, climate change is part of the latest wave of southern oppression and interference in Arctic indigenous lands and ways of life. Where does this leave indigenous peoples who are so often powerless, voiceless and invisible in a world dominated by nation-states?<sup>19</sup> As Watt-Cloutier has questioned: 'Now our climate and our environment is being impacted. What recourse do we have to tell the world to stop?' (Weber, 2004). Answers to this question are evident in the many ways in which Watt-Cloutier and the ICC have portrayed Arctic indigenous peoples and their predicament. Inuit employ images and metaphors through which they appear as being in balance with nature. Such images suggest that they are indicators as well as spokespeople for environmental change, and potential saviors who can help the rest of the world mitigate the losses that indigenous peoples of the Arctic are experiencing. On the trans-boundary pollution issue, Watt-Cloutier has mentioned: 'Here we are, Inuit of the world who have lived in harmony with our surroundings, and we're being bombarded by toxins' (Weber, 2004). In December 2004, during a plenary session at the tenth Conference of the Parties to the United Nations *Framework Convention on Climate Change*, the ICC stated: 'We the Inuit of the world have not only survived but thrived in our Arctic climate; we have thrived – always living in balance with our ecosystem' (Inuit Circumpolar Conference, 2004). Although the mythical Indian living intuitively in harmony with nature has met with much criticism (Gunter, 1999; Krech, 1999), the Inuit nevertheless draw upon the image of the ecologically friendly Indian in publicly defining their identity and positioning themselves in relation to environmental forms of degradation such as pollution and climate change.

An Inuit response to ACIA, authored by Sheila Watt-Cloutier and two of her advisors, Terry Fenge and Paul Crowley, leads off with the following quotation:

The world can tell us everything we want to know. The only problem for the world is that it doesn't have a voice. But the world's indicators are there. They are always talking to us. (Quitsak Tarkiasuk, quoted in Watt-Cloutier et al., 2004)

Here, the Inuit appear as the environment's voice, talking indicators of the world's environmental health. For example, they characterize themselves as the canary in the coalmine, a vulnerable indicator whose failing health portends danger for the world's populations who have yet to experience climate change first-hand. Inuit have similarly described the Arctic as the world's barometer and Inuit peoples as mercury in the barometer. Scientific claims such as the following support these metaphorical images.

The Arctic is extremely vulnerable to climate change, and major physical, ecological, and economic impacts are expected to appear rapidly. (Intergovernmental Panel on Climate Change, 2001: 57)

The Arctic is extremely vulnerable to observed and projected climate change and its impacts. The Arctic is now experiencing some of the most rapid and severe climate change on earth. Over the next 100 years, climate change is expected to accelerate, contributing to major physical, ecological, social, and economic changes, many of which have already begun. Changes in the arctic climate will also affect the rest of the world through increased global warming and rising sea levels. (Arctic Climate Impact Assessment, 2004: 10)

Unlike with past intrusions and injustices, however, southerners now have an unprecedented stake in the fate of the Arctic inhabitants they affect. As Watt-Cloutier has remarked: '... if we protect the Arctic we will save the world' (Watt-Cloutier, 2004).

The Inuit describe themselves as human versions of more familiar and inanimate measures of environmental change such as pollutant concentrations and sea level rise. In multilateral environmental negotiations over persistent organic pollutants the Inuit have pursued a similar goal of humanizing the terms by which these issues are understood and discussed. In the late 1990s, during her terms as President of ICC (Canada) and Vice-President of the pan-Arctic ICC organization, Watt-Cloutier played a prominent role in negotiations to establish and implement the global *Convention on Persistent Organic Pollutants*, sponsored by the United Nations Environment Programme (UNEP). POPs are toxic carbon-based contaminants (such as dioxin, lindane, and chlordanes) that are emitted via industrial activities in the USA, Europe, Asia, and other regions south of the Arctic. These chemicals are carried by wind, air, and water currents to the Arctic, where they are deposited after encountering the region's cold temperatures. Prior to the involvement of Arctic indigenous peoples in negotiations on POPs, the debate tended to center on environmental processes and the risks associated with them. Watt-Cloutier and other leaders from the region are credited with calling attention to the impact of POPs on the Arctic. Watt-Cloutier and the

ICC, with its observer status in the negotiations, is noted for highlighting (via lobbying, interventions, and so on) the bioaccumulation of POPs in the fatty tissues of marine mammals such as seals and whales, which are traditional staples of many indigenous diets in the Arctic. Contamination of these animals thus has consequences not only for the health, but also for the spirituality, social relationships, culture, and economic well-being of indigenous peoples (Karaowski, 2004).

Watt-Cloutier and the ICC are also credited with providing the negotiations on POPs with a powerful symbol of the human lives, experiences, and relationships that motivate the deliberations. Through their work in the POPs arena, the ICC established itself as a highly visible and listened-to representative on the global stage. During the second meeting of the Intergovernmental Negotiating Committee in Nairobi, Kenya, in 1999, Watt-Cloutier presented an Inuit carving of a mother and child to Klaus Toepfer, Executive Director of UNEP. This carving continued to reside on the Chair's table at POPs negotiations and is widely cited as representing the conscience of the negotiations (Downie & Fenge, 2003; Karaowski, 2004). The carving represents, in part, what is most at risk in the face of POPs contamination and adverse environmental change in general. Watt-Cloutier describes how the ICC spoke from the heart and drew upon Canadian research at the POPs negotiating sessions. She proudly recounts how the ICC, with support from the Alaskan member of the US delegation, drafted a clause that the Intergovernmental Negotiating Committee (INC) included in the convention's preamble. This clause, describes Arctic ecosystems and indigenous communities as 'particularly at risk because of the biomagnification' of POPs. It also refers to the contamination of traditional foods in the Arctic as a public health issue. According to Watt-Cloutier, the inclusion of this clause, 'put Inuit and Canada on the map' (Watt-Cloutier, 2004).

As with POPs, the ICC is attempting to humanize climate change and to make visible and tangible its consequences for indigenous peoples' experiences. As the ICC details indigenous encounters with climate change, they draw upon ACIA findings to buttress their authority and credibility. They similarly reference ACIA as they express interest in forging alliances with inhabitants of similarly vulnerable regions, such as low-lying islands and coastal states (Inuit Circumpolar Conference, 2004). With this scientific backing, the ICC again describes its role as one of humanizing global change.

Global Climate Change negotiations are highly detailed and technical. There were thousands of delegates and I wondered how we could possibly inject the human dimension, the Arctic voice into the global debate. Had we forgotten the dramatic predictions of changes to our homeland, the Arctic; had we forgotten the Small Island States in the Pacific that may be underwater within my lifetime; had we forgotten the effects on our prairie farmers? The human impacts of climate change seemed to be lost in the technical detail. (Watt-Cloutier, 2004)

This humanization theme is critical to a major initiative that the ICC spearheaded, a petition to the Inter-American Commission on Human Rights, for a declaration stating that greenhouse gas emissions are destroying the

Inuit way of life and constitute a violation of human rights (Earthjustice, 2004). On 7 December 2005, the ICC filed a petition with the Commission in hopes of defending their ways of life against emissions of greenhouse gas, 40% of which derive from the Arctic states.<sup>20</sup> The petition of 163 pages calls on the USA to place mandatory limits on its greenhouse gas emissions and contains the testimony of more than 60 hunters. With the petition the ICC, working with attorneys from Earthjustice and the Center for International Environmental Law (CIEL), seeks to demonstrate that climate change goes against the 1948 American Declaration on the Rights and Duties of Man (Watt-Cloutier et al., 2004). ICC uses ACIA findings about climate change effects on indigenous cultures, health, and livelihoods to support their petition (Earthjustice, 2004). The organization also views the petition as an opportunity to capture media attention and to communicate with governments, non-governmental organizations and the general public about cultural and human consequences of climate change in the Arctic. As with the preambular clause in the POPs convention, Watt-Cloutier has described the human rights petition as another vehicle for buttressing the representative status of the Inuit and putting them 'on the political map' (Watt-Cloutier, 2004).

## Representations and Representatives

Scientific frameworks, practices, and findings in Arctic climate change science are emerging alongside newly recognized indigenous experts and political voices. The mutually reinforcing relationship that links climate change science and indigenous politics allows us to draw from and build upon STS scholarship on visual representation, to accept Latour's challenge to explore the roles of scientists and spokespeople, and to push beyond conventional notions of globalization. New depictions and knowledge of climate change and the practices that lay behind them also raise important questions about visibility, invisibility, and accountability in global change science.

ACIA's photographs constitute a novel form of representation for scientific assessments, one that is produced outside of the laboratory and is only indirectly reflective of scientific data. Yet, these images offer a lens into changing ideas about climate change, not only as a physical phenomenon, but also as a social and cultural one. ACIA, like a number of recent publications on global change in the Arctic, uses professional photographs to illustrate the ways of life, traditions, and human-environment relationships that climate change is putting at risk (National Science Foundation, 1997; Krupnik & Jolly, 2002; World Wildlife Fund, 2004). And, although these pictures depart from the charts, graphs, and drawings more usually included in scientific research, they nevertheless enliven, if not strengthen, the persuasive power of scientific claims. The photographs also provide a lens into the ways in which scientists conceive of and examine global warming and its impacts through concepts such as vulnerability and adaptation. These photographs illustrate a science increasingly attentive to local manifestations of climate change and its implications for particular peoples, human experiences and responses. Photographs of indigenous peoples in ACIA's synthe-

sis report indicate broader changes in the meaning of climate change, in the tools and resources brought to bear in the production of climate change knowledge, and in the audiences and potential audiences who are and should be watching and reacting to this phenomenon as it unfolds.

Questions of visual representation in the Arctic case are closely coupled with questions of political representation. Latour's reflections on scientists as spokespeople for their objects offer a starting point for inquiring into more complex scientist-object relationships in the context of Arctic climate change. Arctic indigenous peoples constitute an at-risk population. Scientists, along with indigenous peoples, have gone about the business of understanding the environmental changes that these peoples are experiencing and will experience, their capacities to adapt to change, and the implications for economies and ways of life. In one sense, science serves as spokesperson for Arctic indigenous peoples, validating and publicizing ways in which activities outside of the Arctic threaten the lives of environments and peoples within the region. But in other ways ACIA, with its approach to climate change knowledge production and its findings and the presentation of its findings, buttresses indigenous peoples both as objects of scientific inquiry and as advocates for climate change mitigation. ACIA joins other global environmental change research initiatives in recognizing Arctic indigenous peoples as experts with specialized knowledge about the manifestations of climate change in Arctic environments and their implications for indigenous ways of life. Indigenous peoples were centrally involved in ACIA's preparation. This recognition helps to validate indigenous claims about threats they face from climate change, while the expert status of indigenous peoples enhances the credibility and authority with which they speak out on climate change. ACIA also presents scientifically derived claims that confirm and complement indigenous observations about effects of climate change in and around their communities. Indigenous peoples, such as those belonging to the ICC, refer to these findings as they speak out on climate change and argue for policies that curb greenhouse gas emissions.

Globalization, described by its critics as a threat to democracy, is generally characterized as a process that overtakes the local, homogenizing culture and diversity, while elevating economics (Jasanoff & Martello, 2004). Certain attempts to understand and protect the global environment, however, appear to foster a different type of globalization. Some forms of environmental globalization focus attention on 'local' people and human-environment systems, embrace unique and previously under-recognized forms of knowledge, and enable new meanings, identities, and social relationships. Global change science is both constructing and being constructed by scientific objects that (in Latourian terms) speak for themselves. Likewise, political representation shapes and is shaped by the ways in which environmental science envisions the world and bolsters or inhibits the visibility and voice of its citizens. The ICC, for example, is both a product and agent of environmental globalization. The authority, credibility, and visibility of this alliance in global environmental institutions derives largely from an at-risk expert status

attained by way of science and scientific recognition, validation, and reliance on indigenous knowledge. With this status, the ICC is attempting to redefine the terms by which scientists, policymakers, and others imagine, debate and manage the global environment.

ACIA illustrates the power of global environmental science and governance to render some people and situations more visible than others. The assessment was conducted under the auspices of a transnational alliance among Arctic countries and indigenous peoples' organizations. The research and analysis supporting ACIA's claims emerged from close collaboration among scientists and indigenous peoples and involved novel methods for exploring, integrating and presenting varied ways of knowing. However, ACIA's work also suggests that particular approaches to knowledge production can privilege certain groups and human experiences over others. Clearly, indigenous peoples are more directly affected by current forms of climate change than any other social groups. It is, therefore, not surprising that a study like ACIA's should pay detailed attention to indigenous communities, heighten their public visibility, and strengthen their standing and voice on climate change issues. However, it is not the signals of climate change, alone, that explain ACIA's focus on particular indigenous peoples; this focus is also a product of the data and methodologies on which scientists rely. In their study of human vulnerabilities and adaptive capacities in the face of global environmental change, scientists seek out closely coupled human–environment systems in which people are highly reliant upon and interactive with their environment. Scientists find some of the best data to support such investigations with indigenous peoples whose livelihoods, cultures, and social relationships are intimately linked to their natural surroundings. Furthermore, these studies, which rely in part on indigenous observations of climate change, tend to emphasize male knowledge and male–environment relationships, as the observations most directly amenable to scientific inquiry derive from responsibilities that have traditionally belonged to men, such as fishing, hunting, and herding. The majority of photographs in ACIA's (Arctic Climate Impact Assessment, 2004) synthesis document, for example, depict men, with women appearing much less frequently.

This emphasis on indigenous peoples, and indigenous males in particular, stands in contrast to ACIA's more generalized, aggregate treatment of non-indigenous peoples as exemplified in the 'People of the Arctic' figures described above. These disparities reflect the impacts of climate change in the Arctic, but also the conceptual frameworks that guide analysis of these impacts. Ideas like vulnerability and adaptive capacity help to direct the researcher's gaze toward indigenous groups and the tight human–environment relationships that facilitate analysis. The same sort of anecdotal evidence that fills the case studies and quotations illustrating indigenous perspectives is much less abundant (or at least has not been collected) from non-indigenous populations. Yet, critiques of Arctic climate change science seldom call attention to the aggregate treatment of non-indigenous populations, explore its potential consequences, or

call on researchers to account for these particular biases in their conceptual frameworks and methodologies.

What implications do these questions of visibility and invisibility hold for climate change activism? It appears that the practices and products of Arctic science are helping to catalyze and to lend considerable support to indigenous peoples who publicize their canary-in-the-coalmine predicament and call on nation-states to reduce greenhouse gas emissions. If researchers were to similarly localize their analyses of climate change and non-indigenous peoples, would these Arctic residents be more apt to mobilize politically? Would anecdotal evidence from non-indigenous peoples about their experiences, concerns, and worries related to climate change contribute to the creation of new identities and voices in climate change politics? The ACIA case suggests affirmative answers to these questions. A *TIME* CNN poll indicated that by April 2006, 85% of Americans believed that global warming is occurring. *TIME* magazine suggests that as scientific research and catastrophes such as Hurricane Katrina reveal to Americans their own vulnerabilities in the face of rising global temperatures, US residents are increasingly accepting of climate change as reality (Kluger, 2006). When and how these residents ultimately respond to climate change may depend, in part, on the ways in which climate change science engages with and represents them.

## Notes

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1. Climate change science has traditionally involved systematic knowledge of physical, material, and social worlds gained through observation and experimentation in a wide array of disciplinary fields such as biology, ecology, geography, and economics. As discussed below, the practice of and participants in what has historically been considered climate change science is changing, along with answers to questions of what counts as relevant knowledge and who counts as a valid knowledge holder.
2. The term 'scientific representation' is used broadly here and refers to visual images that accompany the scientific texts discussed in the paper, whether or not these images are the work of scientists themselves.
3. ACIA publications contain myriad forms of visual representation: photographs of people, animals and landscapes; charts, graphs, maps, and so on. This paper focuses primarily on the photographs of indigenous peoples, one of many forms of representation, contained in the assessment's synthesis report, *Impacts of a Warming Arctic*.
4. <[www.ifg.org/programs.htm](http://www.ifg.org/programs.htm)>.
5. <[www.usgcrp.gov/usgcrp/nacc/background/workshops.htm](http://www.usgcrp.gov/usgcrp/nacc/background/workshops.htm)>, accessed 18 July 2007.
6. Personal communication with Susan Hassol (24 February 2005) and with Robert Corell (8 March 2005).
7. <[www.iisd.org/casl/projects/inuitobs.htm](http://www.iisd.org/casl/projects/inuitobs.htm)>.

8. Watt-Cloutier, Fenge and Crowley, available at: <[www.inuitcircumpolar.com/index.php?ID=267&Lang=En](http://www.inuitcircumpolar.com/index.php?ID=267&Lang=En)>, accessed 8 May 2006.
9. Pictures of indigenous peoples and Arctic researchers are not new to Arctic science generally. Scientific publications about the Arctic have long included photographs of both Arctic peoples and researchers.
10. <[www.taiga.net/acia/index.html](http://www.taiga.net/acia/index.html)>.
11. Arctic Climate Impact Assessment (ACIA), Assessment Steering Committee (2000) 'Implementation Plan' (September), p. 16.
12. <[www.taiga.net/acia/background.html](http://www.taiga.net/acia/background.html)>.
13. Personal communication with Susan Hassol (21 November 2006).
14. To view Figure 1 in full color and its original format visit <<http://amap.no/acia/>> and download the pdf file for Key Finding 8. Figure 1 appears on p. 97.
15. To view this photograph visit <<http://amap.no/acia/>> and download the pdf file for Key Finding 8. The image appears on p. 93.
16. To view Figure 2 in full color and its original format visit <<http://amap.no/acia/>> and download the pdf file for Key Finding 8. Figure 2 appears on p. 94.
17. ©ACIA, 2004/Map ©Clifford Grabhorn, 2004.
18. Interview with ICC staff member, 5 March 2005.
19. See Wilmer (1993).
20. The Arctic states are Canada, Denmark, Finland, Iceland, Norway, Sweden, the Russian Federation, and the USA.

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